WHAT IS CLAIMED IS:

1. A substrate processing chamber comprising:

a chamber body;

a chamber top disposed on the chamber body; and

a transformer-coupled plasma generator plate within the substrate processing chamber having a plurality of transformer cores within the transformer-coupled plasma generator plate and a plurality of through holes forming conduits from a first side of the transformer-coupled plasma generator plate to a second side of the transformer-coupled plasma generator plate, a first conduit passing through a first transformer core.

2. The substrate processing chamber of claim 1 further comprising a second conduit not passing through a transformer core.

3. The substrate processing chamber of claim 1 wherein the plasma generator plate is flat.

4. The substrate processing chamber of claim 1 further comprising a second transformer core within the transformer-coupled plasma generating plate, a first primary coil being disposed to electro-magnetically couple to the first transformer core and a second primary coil being disposed to electro-magnetically couple to the second transformer core, wherein the first primary coil and the second primary coil are connected to each other in series.

5. The substrate processing chamber of claim 1 wherein the toroidal transformer core comprises ferrite material.

6. The substrate processing chamber of claim 1 wherein the transformer-coupled plasma generator plate includes a dielectric spacer between the first side and the second side, and a remainder of an outer surface of the generator plate comprises an electrical conductor.

7. The substrate processing chamber of claim 6 wherein the dielectric spacer is disposed within a conduit through the transformer-coupled generator plate.

8. The substrate processing chamber of claim 1 further comprising an alternating-current power supply configured to operate at a frequency of about 1 KHz-2 MHz.

9. A substrate processing chamber comprising:

a chamber body;

a chamber top disposed on the chamber body;

an alternating-current power supply; and

a transformer-coupled plasma generator plate having a plurality of through holes forming conduits from a first side of the transformer-coupled plasma generator plate within the substrate processing chamber to a second side of the transformer-coupled plasma generator plate within the substrate processing chamber, a first portion of the conduits passing through centers of a plurality of toroidal transformer cores within the generator plate and a second portion of the conduits not passing through centers of transformer cores, the generator having a first surface comprising metal, a second surface comprising metal, and a plurality of dielectric spacers disposed between the first surface and the second surface in each of the first portion of the conduits.

10. A plasma generator plate comprising:

a first side;

a second side;

a first conduit passing from the first side to the second side through a first transformer core within the plasma generator plate;

a second conduit passing from the first side to the second side through a second transformer core.

11. The plasma generator plate of claim 10 further comprising a first dielectric spacer in a first secondary current path around the first transformer core.

12. A method of processing a substrate in a plasma processing system, the method comprising:

providing a substrate to a substrate holder in a processing chamber of the plasma processing system;

flowing a plasma precursor into a multi-core transformer-coupled plasma generator;

generating a plasma from the plasma precursor with the multi-core transformer coupled plasma generator; and

processing the substrate.

13. The method of claim 12 wherein the multi-core transformer-coupled plasma generator is within the processing chamber.

14. The method of claim 13 wherein the multi-core transformer-coupled plasma generator is a generator plate comprising a plurality of transformer cores within the generator plate and a plurality of through-holes forming conduits from a first side of the generator plate to a second side of the generator plate.

15. The method of claim 12 wherein plasma formed by the multi-core transformer-coupled plasma generator is coupled to the processing chamber through a conduit.

16. The method of claim 15 wherein the multi-core transformer-coupled plasma generator has a first conduit passing through a first transformer core and through a second transformer core.

17. The method of claim 15 wherein the multi-core transformer-coupled plasma generator has a first conduit passing through a first transformer core and a second conduit passing through a second transformer core.

18. A plasma processing system comprising:

a first substrate support structure configured to hold a first substrate in a processing chamber;

a second substrate support structure configured to hold a second substrate in the processing chamber; and

a transformer-coupled plasma generator within the processing chamber disposed between the first substrate support structure and the second substrate support structure.

19. The plasma processing system of claim 18 wherein the transformer-coupled plasma generator includes a toroidal transformer core.

20. The plasma processing system of claim 18 wherein the plasma generator comprises a plasma generating plate having a plurality of transformer cores within the plasma generating plate and a plurality of through holes forming conduits from a first side of the plate to a second side of the plate.

21. A method of simultaneously processing substrates in a plasma processing system, the method comprising:

providing a first wafer and a second wafer to a processing chamber;

flowing plasma precursor into the chamber;

generating a plasma with a transformer-coupled plasma generator disposed between the first wafer and the second wafer; and

simultaneously processing the first wafer and the second wafer.

22. A plasma generator comprising:

an inlet in fluid communication with;

a first conduit passing through

a first toroidal transformer core and through

a second toroidal transformer core;

a second conduit completing a plasma current circuit, in cooperation with the first conduit, around the first toroidal transformer core and around the second toroidal transformer core; and

an outlet in fluid communication with the first conduit.

23. A plasma generator comprising:

an inlet in fluid communication with

a first conduit passing through a first transformer core and with

a second conduit passing through a second transformer core;

a third conduit in fluid communication with the first conduit to complete a first plasma current circuit around the first transformer and in fluid communication with the second conduit to complete a second plasma current circuit around the second transformer; and

an outlet in fluid communication with at least the first conduit and the second conduit.

24. A substrate processing system comprising:
a process chamber with a chamber inlet;
a chamber exhaust; and
a transformer-coupled plasma generator having a first core,
a first conduit passing through the first core,
a second core,
a second conduit passing through the second core, and
a third conduit in fluid communication with the first conduit and the second conduit to complete a plasma current circuit path through the process chamber.

25. The substrate processing system of claim 24 wherein the third conduit is a center conduit completing a first plasma current circuit path around the first core through the process chamber and the first conduit and completing a second plasma current circuit path around the second core through the process chamber and the second conduit.

26. The substrate processing system of claim 24 wherein the first conduit and the second conduit comprise metal and further comprising a dielectric spacer in the plasma current circuit path.

27. The substrate processing system of claim 24 further comprising:
a fourth conduit passing through
a third core; and
a fifth conduit passing through
a fourth core.

28. The substrate processing system of claim 24 further comprising:
a first primary coil disposed to couple electro-magnetic energy to the first core;
a second primary coil disposed to couple electro-magnetic energy to the second core;

a third primary coil disposed to couple electro-magnetic energy to the third core;

a fourth primary coil disposed to couple electro-magnetic energy to the fourth core, wherein the first primary coil, the second primary coil, the third primary coil, and the forth primary coil are coupled to an AC power supply.

29. The substrate processing system of claim 28 wherein the first primary coil, the second primary coil, the third primary coil, and the fourth primary coil are connected in series with the AC power supply.

30. The substrate processing system of claim 28 wherein the first primary coil, the second primary coil, the third primary coil, and the fourth primary coil are connected in parallel to the AC power supply.

31. A plasma generator comprising:

an inlet configured to receive a plasma precursor, the inlet in fluid communication with a first plasma current path and with a second plasma current path;

a first conduit passing through

a first transformer core;

a second conduit passing through

a second transformer core, wherein the first conduit is essentially co-linear with the second conduit.

32. A plasma generator comprising:

an outer shell surrounding a first inner shell housing a first toroidal transformer core; and

a second inner shell housing a second toroidal transformer core, wherein the first toroidal transformer core and the second toroidal transformer core are disposed along a common center axis.

33. The plasma generator of claim 32 wherein the first inner shell is supported within the outer shell by a web allowing circulation of secondary plasma current around the first inner shell within the outer shell.

34. The plasma generator of claim 33 wherein the web contains an electrical lead connected to a primary coil disposed to couple electro-magnetic energy to the first toroidal transformer core.

35. The plasma generator of claim 32 wherein the first inner shell includes a shaped bottom portion to provide a circular cross-section to the inner shell.

36. The plasma generator of claim 32 further comprising:

an inlet; and

an outlet, both the inlet and the outlet lying along the common center axis.

37. An ion implantation system comprising:

an ion source having a toroidal plasma generator, and

an ion source aperture aligned essentially along a center line of the toroidal plasma generator.

38. The ion implantation system of claim 37 further comprising a first extraction electrode disposed to accelerate ions from the ion source toward a second extraction electrode.

39. The ion implantation system of claim 37 wherein the toroidal plasma generator includes a first core and a second core, the first core and the second core being aligned essentially along a center line of the toroidal plasma generator.

40. A method of providing ions to an ion implantation system, the method comprising:

providing an ion precursor to a transformer-coupled toroidal plasma generator in an ion source;

ionizing at least a portion of the ion precursor into ions, the ions having a greater density at a center of the transformer-coupled toroidal plasma generator and extending along a line through the center of the transformer-coupled toroidal plasma generator; and

ejecting a portion of the ions out of the ion source.

41. A plasma torch head comprising:

an outer nozzle;

an inner nozzle, the inner nozzle including a conduit passing through the inner nozzle from an inlet side toward an outlet,

a toroidal transformer core surrounding the conduit; and

a bypass providing a return path for a secondary plasma current circuit around the toroidal transformer core.

42. The plasma torch head of claim 41 wherein the inner nozzle comprises metal and further including a dielectric spacer in the inner nozzle to prevent an electric path through the inner nozzle around the toroidal transformer core.

43. The plasma torch head of claim 41 wherein a first gas is flown through the conduit and a second gas if flown through the bypass, the first gas being different from the second gas.

44. The plasma torch head of claim 43 wherein the first gas is oxygen and the second gas is either propane or hydrogen.

45. The plasma torch head of claim 41 further comprising a primary coil disposed to couple electro-magnetic energy to the toroidal transformer core wherein the primary coil and the toroidal transformer core are enclosed within the inner nozzle.

46. A method of cutting material using a plasma torch, the method comprising:

flowing a plasma precursor in a conduit through a center of a toroidal transformer core of a plasma generator in an inner nozzle of a plasma torch;

forming plasma from the plasma precursor;

completing a plasma current secondary circuit around the toroidal transformer core through a bypass; and

transporting plasma out an outlet of the plasma torch.

47. The method of claim 46 further comprising flowing carrier gas through the bypass.

48. The method of claim 46 wherein the forming plasma step includes providing a primary voltage to a primary coil coupling electro-magnetic energy to the toroidal transformer core, the primary voltage being an alternating-current voltage less than about 115 Volts.

49. An ion source for an ion milling apparatus, the ion source comprising:

a transformer-coupled toroidal plasma generator (having a primary coil disposed to couple electro-magnetic energy to a toroidal core, the transformer-coupled toroidal plasma generator disposed to provide plasma along a center line of the transformer-coupled toroidal plasma generator toward an accelerator plate.

50. The ion source of claim 1 wherein the transformer-coupled toroidal plasma generator further includes a second toroidal core.

51. A method for providing ions to an ion milling apparatus, the method comprising:

providing an ion precursor to a transformer-coupled toroidal plasma generator;

ionizing at least a portion of the ion precursor to form ions, the ions being concentrated along a center axis of the transformer-coupled toroidal plasma generator; and

ejection a portion of the ions toward an accelerator plate.

52. The method of claim 51 wherein the ion precursor forms reactive ions.